Global Study: What Characteristics of a Country Impact Mental Health Nationwide?

Alina Jiang, Ani Ponugoti, Kimberly Yang

Introduction

- The World Health Organization (WHO) and the Global Burden of Disease estimate that almost 800,000 people die from suicide every year.
- A research by Hannah Ritchie et al suggested that suicide is a leading cause of death in young people.
- We chose this topic because interpreting the causes of suicides is crucial for global well-being. We want our research to be more inclusive, because a majority of studies on psychological well-being are biased toward Western Populations.

Research Questions

What holistic factors influence the mental health of a population?

- Do countries that consume more alcohol have higher suicide rates?
- Do countries who have less access to internet have higher suicide rates?
- Does a country's religion being Christianity or Islam (the world's two largest religions) affect its suicide rate in a meaningful way?

Data Summary

The data were collected from multiple sources and merged in R on the basis of country. We removed Lesotho from our dataset, because this country has an exceptionally high suicide rate that can be considered as an outlier. The dataset has 125 observations and 8 variables (three qualitative and five quantitative).

Variable	Description
Policy	Whether a country has a stand alone policy for mental health
alcconsumption	Estimated average alcohol consumption per person aged 15 and older in liters of pure alcohol
GDP	Gross Domestic Product of each country; was converted to units of 10^{11} dollars
Education	Average number of years of schooling a child of school entrance age can expect to receive
Religion	Predominant religion in each country
human_freedom_score	Freedom rating of country based on personal, civil, and economic freedom for the individual country; higher represents more freedom
unemployment	Percentage of the labor force population aged 15 and older that is not in paid-employment or self-employment but is available for work
Internet_users	Percentage of the total population who access to the internet
SuicideRate	Suicide rates per 100,000 population

Multicollinearity:

No variables highly correlated with each other

Stage One: Add Quantitative Predictors & Quantitative x Quantitative Interactions

Initial: $\text{SuicideRate} = \beta_0 + \beta_1\text{unemployment} + \beta_2\text{alcconsumption} + \beta_3\text{GDP} + \beta_4\text{internet\_users} + \beta_5\text{human\_freedom\_score} + \varepsilon_i$

Final: $\text{SuicideRate} = \beta_0 + \beta_1\text{alcconsumption} + \beta_2\text{internet\_users} + \varepsilon_i$

Stage Two: Add Qualitative Predictors and Qualitative x Qualitative interactions

DummyM = {1 if a majority of the country practices Islam, 0 otherwise}

DummyC = {1 if a majority of the country practices Christianity 0 otherwise}

Initial: $\text{SuicideRate} = \beta_0 + \beta_1\text{alcconsumption} + \beta_2\text{internet\_users} + \beta_3\text{dummyC} + \beta_4\text{dummyM} + \beta_5\text{dummypolicy} + \beta_6\text{dummypolicy*dummyC} + \beta_7\text{dummypolicy*dummyM} + \varepsilon_i$

Final: $\text{SuicideRate} = \beta_0 + \beta_1\text{alcconsumption} + \beta_2\text{internet\_users} + \beta_3\text{dummyC} + \beta_4\text{dummyM} + \varepsilon_i$

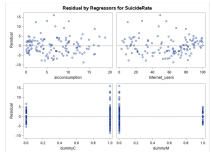
Stage Three: Add Quantitative x Qualitative Interactions

Initial: $\text{SuicideRate} = \beta_0 + \beta_1\text{alcconsumption} + \beta_2\text{internet\_users} + \beta_3\text{dummyC} + \beta_4\text{dummyM} + \beta_5\text{internet\_userdummyC} + \beta_6\text{internet\_user*dummyM} + \varepsilon_i$

Final Model: $\text{SuicideRate} = \beta_0 + \beta_1\text{alcconsumption} + \beta_2\text{internet\_users} + \beta_3\text{dummyC} + \beta_4\text{dummyM} + \varepsilon_i$

Assumptions:

Lack of fit, Homoscedasticity, Normality, and Residual Correlation assumptions are all met.



Durbin-Watson D	1.789
Pr < DW	0.1202
Pr > DW	0.8798
Number of Observations	124
1st Order Autocorrelation	0.064

Conclusion

Final Prediction Equation:

$$\widehat{SuicideRate} = 11.51 + 0.36alcconsumption - 0.06internet\_users - 1.32dummyC - 3.08dummyM$$

Interpretation:

Countries that consume more alcohol and/or have less access to the internet have slightly higher suicide rates, and a country's predominant religion being Christianity or Islam may contribute to a lower suicide rate.

Example Observation:

Predicted Suicide Rate for Mexico: 11.51 + 0.36(8.55) - 0.06(65.8) - 1.32 = 9.32

Actual Suicide Rate of Mexico: 5.29

Residual: -4.03

Model Adequacy:

The Adjusted R-Square value is 0.198, which is concerning. This means that 19.8% of the variation in suicide rate is explained by the model, which is a very low proportion. The Root MSE indicates that the average distance between the predicted suicide rates in the model and the actual suicide rates in the dataset is 4.32, which is also fairly high and concerning. Thus, we conclude that this model is not very useful in predicting suicide rates of countries and we should look into different variables and methods.

Limitations

Limited amount of data available

Year of data collection for alcohol consumption was not specified

Individuals vary and there are cultural factors/values that cannot be quantified or qualified

Future Research

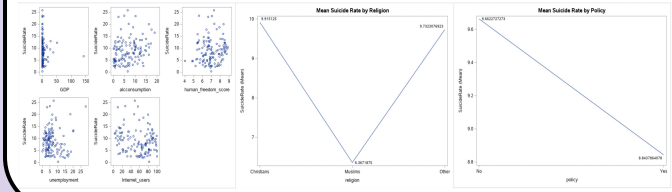
Look for data with more localized samples

Explore variables such as physical location (i.e. latitude or longitude, or regional such as East or West)

Look into logistic regression

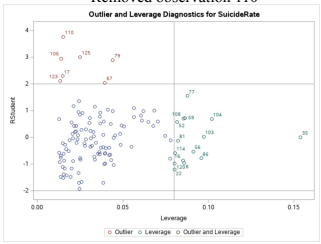
Exploratory Data Analysis

Scatterplot for alcohol consumption and suicide rate shows moderate positive linear relationship; internet users and suicide rate appear to have slight negative correlation. Qualitative variables have graphs shows that religion and policy have means that are significantly different from each other.



Outliers and Influential Points

Removed observation 110



Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	11.50631	1.42723	8.06	<.0001
alcconsumption	1	0.35697	0.10428	3.42	0.0008
Internet_users	1	-0.06103	0.01502	-4.06	<.0001
dummyC	1	-1.31889	1.36055	-0.97	0.3343
dummyM	1	-3.07717	1.43301	-2.15	0.0338

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	642.09564	160.52391	8.60	<.0001
Error	119	2222.16977	18.67370		
Corrected Total	123	2864.26541			

Root MSE	4.32131	R-Square	0.2242
Dependent Mean	8.89153	Adj R-Sq	0.1981
Coeff Var	48.61988		

Variable Screening

Confirms that we should use the two quantitative variables that we found important from EDA

Summary of Stepwise Selection

Step	Variable Entered	Variable Removed	Number Vars In	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	alcconsumption		1	0.0693	0.0693	16.6459	9.16	0.0030
2	Internet_users		2	0.1077	0.1770	2.7169	15.97	0.0001

External Model Validation

Sum of Residuals	0
Sum of Squared Residuals	2222.16977
Predicted Residual SS (PRESS)	2380.36943

	R^2	MSE
Fitted Model	0.2242	18.6737
Jackknife	0.16894	20.1726

$R^2_{jackknife} < R^2_{model}$ and $MSE_{jackknife} > MSE_{model}$

Therefore, the model and its parameters are adequate

Works Cited

1. World Health Organization. (n.d.). Suicide rates. World Health Organization. Retrieved December 1, 2021, from https://www.who.int/data/gho/data/themes/mental-health/suicide-rates.
2. Hannah Ritchie, Max Roser and Esteban Ortiz-Ospina (2015) - "Suicide". Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/suicide' [Online Resource]
3. GDP (current US$), The World Bank. https://data.worldbank.org/indicator/NY.GDP.MKTP.CD
4. Human Freedom Index, CATO Institute. https://www.cato.org/human-freedom-index/2020
5. Religious composition by country, Pew Research Center. https://www.pewforum.org/2015/04/02/religious-projection-table/2020/number/all/
6. Stand-alone policy or plan for mental health, World Health Organization. https://www.who.int/data/gho/data/indicators/indicator-details/GHO/stand-alone-policy-o r-plan-for-mental-health
7. Expected years of schooling, Human Development Reports. http://hdr.undp.org/en/indicators/69706#
8. Unemployment, Human Development Reports. http://hdr.undp.org/en/indicators/140606#
9. Internet users, Human Development Reports. http://hdr.undp.org/en/indicators/43606# 10. Alcohol Consumption, Gapminder. https://www.kaggle.com/sansuthi/alcohol-consumption